

REMARKS

The Office Action of June 2, 2006, has been reviewed and the Examiner's comments carefully considered. The amendments to the claims are supported in the original claims and in the specification as discussed below. This amendment has been drafted after consultation with the inventors and the examiner to clarify the record and correct informalities submitted in the amendment of September 2, 2006. The examiner is thanked for the courtesies extended in the brief telephone interview regarding the structure of the claims. No new matter has been added and Applicants submit that these amendments place all of the claims in condition for allowance.

The cancellation of claim 1 is believed to address the examiners stated rejections of claim 1-20 under 35 U.S.C. 112, first paragraph. Claim 1 has been replaced herein with new claim 30 directed toward a slurry system for removal of a copper metal overburden from a microelectronic substrate. This claim has been drafted to define the structural features of the two slurry system of the present invention that is not taught in the prior art. This claim recites that "said first slurry has higher concentration of said abrasive than said second slurry and wherein the second slurry has less than 70% of the static etch rate of the first slurry". The support for the static etch rate can be found in the original application in paragraph 62 of the published application document. Claim 30, as drafted, is not believed to raise any issues under 112, first paragraph1.

The present amendment intends to bring the remaining method claims in conformance with the arguments presented in the Appeal Brief of record and in compliance with the explicit teachings of the specification. The present amendment also adds structural limitations into the apparatus claims of the application that are supported in the specification.

The present claimed method is directed to a method of removing a metal, such as copper, overburden layer on a microelectronic substrate. It is important to clarify that "removal of the overburden" as described in this application will mean, to one of ordinary skill in the art, that the overburden is almost entirely, or substantially, removed by the method of the present invention. A process, such as the present invention, that leaves trace amounts of the overburden in amounts less than 5% will be considered to be effective for "removing the overburden", as such trace amounts of overburden can be removed in subsequent processing that is particularly designed to remove the barrier layer, without detrimentally effecting the operation of the barrier layer removal process. The specification, within the

examples, clearly supports that the process of the present invention will remove more than 95% of the metal overburden in two stage process, such that, upon visual inspection less than 5% of the overburden can be seen (see specifically examples 9 and 10). These trace amounts would, naturally, be visible on the remaining barrier layer. As one skilled in the art would understand, these trace amounts of overburden would be expected in the “low” areas of the barrier layer.

The method claims have been amended herein to more precisely conform to the specification in that the second stage is “substantially” removing the residual portion. Further, the claims have been amended to provide support in the claim language that is taken from the specification as to precisely what is meant by “substantially” within the claims to avoid indefinite problems. Specifically the process of the present invention removes the overburden such that visual inspection of the substrate after the two stage process will evidence that more than 95% of the overburden is removed, and therefore trace amounts of less than 5% remain.

The claim language is believed to be in better conformance with the specific language of the specification and is believed to highlight the distinction between the present invention and the applied prior art.

The prior art does not guarantee a STOP of the first polishing stage prior to polishing into the barrier layer, and it specifically uses the second slurry to remove the barrier layer (and any residual overburden that may or may not have been present). The applied prior art is the traditional two step process for removal of the overburden primarily in step 1 and the barrier layer primarily in step 2. The first step is used to polish down “into or close to” the barrier layer, with the first polish being primarily designed for the overburden removal. The second stage is designed to remove the barrier layer and the slurry is constructed accordingly. The first polishing step may in fact extend into the barrier layer, and as such fails to affirmatively teach the positive step of assuring the termination of the initial polishing step in the overburden.

In the method of the present invention the initial polishing step is terminated prior to removal of all of the metal overburden of the microelectronic substrate. The method of the present invention utilizes the second claimed slurry to remove substantially the residual overburden, leaving only a trace amount of the overburden, and necessarily leaving the barrier layer as well. As described in the examples of the present application, visual inspection indicated that more than 95% of the overburden is removed by the second stage,

and, therefore, less than 5% of the overburden remains after the second stage of the present invention. These trace amounts will be removed in the subsequent barrier layer removal process, that is not part of the present claimed invention.

As discussed in the applicant's appeal brief, the prior art does not teach or suggest such a method. The examiner is correct that previous functional limitations are met if the prior art could possibly be used to perform the claimed function in a PRODUCT claim. Further the examiner is thanked for indicating that the relevant arguments should be presented for the method claims (previously claims 24-29). The present amendment is believed to attend to this in the manner suggested by the examiner. The functional limitations (i.e. the method steps) of the present claimed method are not taught or suggested in the applied prior art, mainly for all the reasons already of record and reiterated above. The applicants have also conformed the claim language to language from the specification to avoid new matter issues.

Withdrawn claim 21 has been cancelled.

New claim 36 has been added and is directed to the elected invention method for polishing a microelectronic substrate to remove a metal overburden of the microelectronic substrate. Further, in addition to the above distinctions relative to independent method claim 24, claim 36 also defines that the static etch resistance of the second slurry is less than the static etch rate of the initial slurry. See paragraph 62 of the publication to evidence support in the original specification. The relevant prior art fails to teach or even suggest a two stage slurry system in which the static etch rate of the second slurry relevant to the first slurry is lowered at all. Column 4, lines 50-65 of the '748 patent identifies the composition of the two slurries that are found in the '748 patent. Static etch rate of a slurry is effectively the chemical removal rate for the slurry (without any mechanical energy applied). As described in the present specification, the total removal rate for a given CMP step is the combination of the static etch rate (roughly the "Chemical" portion of "Chemical Mechanical Polishing" or CMP) and the mechanical removal rate (the Mechanical portion of CMP). The '748 patent discloses the total copper removal rate (which is the sum of the chemical and mechanical components) in the second slurry drops from 3800 to 1600 Angstroms/minute. The '748 patent attributes this reduction to the decrease in the abrasive content of the second slurry. It is noted that to reduce the total removal rate by a little more than ½ the abrasive content in the given example is reduced by a factor of 6. The '748 patent does not expressly teach the

relative static etch rates of the two slurries, such that it does not teach the limitation of claim 36.

Further, several prominent factors evidence that the '748 patent does not suggest this limitation of a lower static etch rate in the second slurry. In the '748 patent disclosure the ammonium citrate concentration has been doubled from 0.025M to 0.05M. Moreover, the reduction of the abrasive content (by a factor of 6) would be expected to have no effect on the static etch rate of the second slurry composition. Finally the increase in the inhibitor (1,2,4-triazole) is only 60% from slurry 1 to slurry 2 (0.1M to 0.16M specifically) in the '748 patent. It is known, at least with other triazoles, such as benzotriazole, that at these concentrations the increase in the triazole amount results in a decrease of the static etch rate, but to a much lesser degree than that of the ammonium citrate. All of these factors clearly demonstrate that the '748 patent clearly does not teach or suggest the lower abrasive content AND the lower etch rate formulation of the second slurry of the two stage slurry system. Claim 36 is believed to distinguish over the prior art for this reason as well.

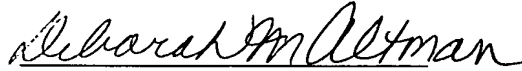
Claim 30 has been added to define the slurry system of the present invention. In accordance with the examiner's suggestions the claim has been drafted to define the STRUCTURAL features of the slurry system that are not found in the prior art of record. As discussed above in connection with method claim 36 the prior art does not expressly teach nor would it suggest to one of ordinary skill in the art, and it arguably teaches away from, the formulation of the second slurry having a lower etch rate than the first slurry of the two stage slurry system. The claims that depend from claim 30, directly or indirectly, are allowable for the same reasons, although these claims are believed to add further specific features that are not addressed in combination with the other aspects of the claims.

In view of the foregoing, reconsideration and withdrawal of the rejection of the remaining claims in light of the amendment and the above cited remarks is respectfully requested. The examiner is requested to contact the undersigned if he believes that such discussion would advance this prosecution and expedite his handling of the matter. The

examiner is again thanked for the suggestions made in the prosecution to date and the undersigned has attempted to follow those guidelines.

Respectfully submitted,

Deborah M. Altman

A handwritten signature in cursive script that reads "Deborah M. Altman". The signature is written in dark ink and is positioned above the printed contact information.

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